REMARKS

The Official Action mailed March 13, 2003 has been carefully reviewed along with the Harmer et al patent (hereinafter "Harmer") cited and applied therein. The claims in the application remain as claims 1-14 and 16-23. These claims define novel and unobvious subject matter under §§102 and 103 and should be allowed. Accordingly, applicants respectfully request favorable reconsideration and allowance.

Acknowledgment by the PTO of the receipt of applicants' papers filed under §119 is noted.

No rejections have been imposed under the second paragraph of §112, and applicants accordingly understand that applicants' claims are deemed by the PTO to be in good form, fully consistent with the second paragraph of §112. Nevertheless, applicants have made a few very minor, cosmetic amendments to place the claims in even better form consistent with U.S. practice. The amendments are not "narrowing" amendments because the scope of the claims has not been reduced. No limitations have been added and none are intended; the meaning of the claims remains the same.

Claims 1-3, 5-7, 9-11, 14 and 16-20 have been rejected under §102 as anticipated by Harmer. In addition,

claims 4, 8, 12 and 13 have been rejected under §103 as obvious from Harmer; and claims 21-23 have been rejected under §103 as obvious from Harmer in view of the Kingery et al publication (reference U), hereinafter "Kingery". These rejections are respectfully traversed.

The PTO appears to misunderstand the Harmer disclosure in that it incorrectly assumes that Harmer's invention uses or controls abnormal grain growth like the present invention. However, Harmer does not mention abnormal grain growth and does not relate to control of abnormal grain growth.

Grain growth consists of normal grain growth and abnormal grain growth[1]. If a seed single crystal is bonded to a polycrystal, thereby inducing boundary curvature, the seed single crystal can grow into the polycrystal by either the normal grain growth mechanism or the abnormal grain growth mechanism. However, in the case of the normal grain growth

[1] Grain growth including both normal grain growth and abnormal grain growth occurs when some small fraction of the grain grows to a large size, consuming the uniform-grain-size matrix as mentioned in Kingery. If the entire growing grains grow at a similar velocity, and thus the resultant size of the grown grains increases while the size distribution of the entire grains is still constant, the grain growth is called NORMAL GRAIN GROWTH. However, if several specific grains grow fast comparatively, and thus the resultant size distribution of the grains exhibits bimodal distribution, the grain growth is called ABNORMAL GRAIN GROWTH (please see the attached copy of " Physical Ceramics, Principles for Ceramic Science and Engineering", Yet-Ming Chiang et al *Physical ceramics: principles of Ceramic Science and Engineering*, John Wiley & Sons, Inc. New York, 1997, pp. 371-386 and table of contents, whose authors are W. David Kingery et al. Kingery is also the author of the non-patent document which the examiner has applied against claims 21-23.)

mechanism, the growth velocity of the seed single crystal is remarkably slower than in the case of the abnormal grain growth mechanism.

In the case of abnormal grain growth, even if boundaries show faceting (i.e. grain boundary curvature is zero), grains can grow continuously (Please see page 386 of "Physical Ceramics, Principles for Ceramic Science and Engineering", attached hereto). However, in the case of normal grain growth, if the grain boundary curvature is zero, grains cannot grow. The present invention uses abnormal grain growth and, therefore, grain boundary curvature between the seed crystal and the solid grains of the polycrystal is not necessary in the present invention. However, as can be readily seen from the Harmer specification (e.g. col. 1, line 48), in Harmer's system **grain boundary curvature is necessary**.

The present invention is characterized by growing the seed single crystal only by the abnormal grain growth mechanism (see claim 1) and controlling the abnormal grain growth for promotion of the seed growth. Harmer neither discloses nor teaches regulation of abnormal grain growth. Harmer adds the "wetting" second phase between the seed single crystal and the polycrystal for promotion of the growth. In other words, the means for promoting the growth of the seed in the present invention is to regulate abnormal grain growth,

while that in Harmer is to add the "wetting" second phase between the seed single crystal and the polycrystal.

A stated at Col. 4, lines 25~27 of Harmer, the growth velocity of the seed single crystal is directly proportional to both the boundary mobility (i.e. the mobility of the boundary between the seed crystal and the solid grains of the polycrystal) and the driving force for the boundary migration (or growth of the seed single crystal). In this regard, the means for promoting the growth velocity in the present invention, i.e. the control of abnormal grain growth, regulates the driving force for the single crystal growth, but there is no change in boundary mobility. However, the means for promoting the growth velocity in Harmer, i.e. the addition of the wetting second phase, does not change the driving force but does improve the mobility of the boundary between the seed crystal and the solid grains of the polycrystal.

The present invention can grow the seed single crystal into the polycrystal at a constant growth velocity depending on the time of heat treatment, while Harmer's method cannot grow the seed single crystal at a constant growth velocity depending on the time of heat treatment. As can be seen from Fig. 10, in Harmer, even if heat treatment continues, the growth velocity jumps only during the formation of the wetting phase and it is nearly zero before the

formation of the wetting phase or after volatilization of the wetting phase. Therefore, one can obtain a large single crystal having a size of several cm by using the present invention when the heat treatment continues for 50 hours or more. However, even if the heat treatment continues for 50 hours or more using Harmer's method, one cannot obtain such a large single crystal.

We summarize the above comparison in a table attached hereto.

Respectfully, it should be clear that Harmer neither discloses nor makes obvious what is claimed, and therefore the rejections based on Harmer alone should be withdrawn. Such is respectfully requested.

With respect to the rejection based on Harmer in view of Kingery, the latter has not been cited to make up for the deficiencies of Harmer, and indeed does not do so. Therefore, even if the proposed combination were obvious, it would not reach the claimed subject matter. Accordingly, the rejection based on the combination of Harmer in view of Kingery should also be withdrawn, and such is respectfully requested.

The prior art documents made of record and not relied upon have been noted, along with the implication that

such documents are deemed by the PTO to be insufficiently pertinent to warrant their application against any of applicant's claims.

Favorable reconsideration and allowance are earnestly solicited.

Respectfully submitted,

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	Present Invention	Harmer
Use of abnormal grain growth	Yes	Not mentioned
Regulation of abnormal grain growth	Yes	Not mentioned
Whether grain boundary curvature is necessary	Not necessary	Necessary
Means for promoting the growth velocity	Control of abnormal grain growth	Addition of a wetting second phase between the seed and the polycrystal
Action of the means for promoting the growth velocity	Increase in driving force	Increase in mobility
The constancy of the growth velocity	The growth velocity is constant throughout heat treatment	The growth velocity largely varied with the time of heat treatment. The substantial growth occurs **ONLY** during a specific period and the growth velocity during most of the other periods is nearly ZERO.
Result of long-term heat treatment (50 hours or more)	Obtain a single crystal having a size of several cm	No matter how long the heat treatment is conducted, the size of the grown single crystal is limited to several mm (see Fig. 10)